



CITY OF SAN BRUNO  
CITY COUNCIL

December 9, 2016

Juliette Hayes  
Chief, Risk Analysis Branch  
FEMA Region IX, Mitigation Division  
1111 Broadway, Suite 1200  
Oakland, CA 94607  
Case No.: 11-09-1227S

Community: City of San Bruno  
San Mateo County,  
CA  
Community No.: 060326

Re: California Coastal Analyses and Mapping Project / Bay Area Coastal Study

Dear Chief Hayes:

This letter responds to the letter reply dated November 10, 2016 from FEMA regarding the Preliminary Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) report for San Mateo County, California dated August 13, 2015.

FEMA has acknowledged that the City's submittal is considered an appeal, that it satisfied the appeal requirements defined in Title 44, Chapter I, Part 67 of the Code of Federal Regulations (44 CFR 67), that it was filed during the 90-day appeal period, and that the basis for the appeal was the methodology used by FEMA to generate the coastal floodplain boundaries (SFHA) and BFEs in the area of San Bruno.

FEMA has determined that changes to the preliminary SFHA, BFE's, flood depths and flood risk zones as shown in the August 13, 2015 Preliminary FIRM are not warranted, and provided six specific deficiency comments on the appeal document submitted by the City to explain the rationale for the denial. We respectfully disagree and have provided responses to those comments in the attached.

We also understand from your letter that the deadline to request a Scientific Resolution Panel (SRP) is 30 days from the date of your above referenced letter. We have therefore attached a duly completed SRP Request Form.



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On behalf of the San Bruno City Council, I would like to respectfully request that FEMA give full and fair consideration of the additional supporting information herein.

Sincerely,

Jim Ruane  
Mayor

Cc - San Bruno City Council  
Shilpa Mulik, Regional Engineer, FEMA, Region IX  
Craig Fugate, Administrator, FEMA, Washington, DC  
David Pine, San Mateo County Supervisor, District 1  
Brian Perkins, Representative Jackie Speier's Office, 14<sup>th</sup> District



## TECHNICAL RESPONSE TO FEMA COMMENTS

FEMA has identified a list of six deficiencies found in the appeal methodology. The City (of San Bruno) has reviewed the discussion about the six deficiencies and prepared the following responses following each comment:

### **FEMA Comment 1**

*The appeal did not claim there were any errors with FEMA's Bay Area Coastal Study modeling approach, but asserted that the approach was generalized and therefore overstated the hazard in comparison with the XP-SWMM 1D/2D modeling approach. The M&N Report also did not use any of the Bay Area Coastal Study analysis of wave effects and overland wave propagation analysis, since the appeal area is inland and removed from any wave effects. In general, the modeling presented in the M&N Report provides an alternative approach to the steady state approach (constant water level) used by FEMA for SFHA and BFE mapping, but no justification for why the City of San Bruno believes the Preliminary FIRM and FIS is scientifically or technically incorrect. The M&N Report states that the Preliminary FIS approach to map coastal flooding limits using a steady-state (static) 1-percent-annual-chance stillwater elevation (SWEL) and projecting that static water level inland from the San Francisco Bay shoreline is overly simplistic and significantly overstates the SFHA boundaries, BFEs, and base flood depths, but does not provide any evidence that the study is scientifically or technically incorrect.*

**City Response:** The City has stated in the cover letter that 1) the proposed BFEs in the City's Preliminary FIRMs are scientifically incorrect; and 2) the designations of the identified SFHAs in the City's Preliminary FIRMs are scientifically incorrect.

The City would like to point out that FEMA's current approach is not a steady state approach (constant water level) as stated in the FEMA Comment 1. Rather, it is a Natural Valley (no modeling or bath-tub) approach. The City is therefore appealing the BFEs and SFHA zone boundaries within the City limits. The basis of City's appeal is "alternative methods or applications result in more correct estimates of base flood elevations, thus demonstrating that FEMA's estimates are incorrect as defined in Title 44, Chapter I, Part 67.6 of the Code of Federal Regulations (44 CFR 67.6)." The City's justification is the BFEs and SFHA zone boundaries within the City limits will be different as shown in Figure 17 of the appeal document (the M&N Report). Figure 17 provided the evidence of errors by comparing results between FEMA's over simplified bath-tub (Natural Valley) approach and a fully dynamic hydraulic and hydrology modeling approach using XP-SWMM 1D/2D modeling software. FEMA's simplified bath-tub approach ignored the flood duration, flood water volume limitation, and terrain changes over the flood course.

### **FEMA Comment 2**

*The M&N Report's primary appeal concern is with the FEMA-adopted method for the Bay Area Coastal Study, which assumes the "Natural Valley" or "Without Levee" approach. In this*



*approach the 1-percent- annual-chance SWEL is extended behind or landward of non-accredited structures and non-levee embankments to a point where the 1-percent-annual-chance SWEL floodplain boundaries are equal to controlling ground elevations. In the appeal areas, this would be a flood elevation of approximately 10.4 feet NAVD88. This approach adopted in San Francisco Bay is detailed in the FEMA July 2013 report, "Analysis and Mapping Procedures for Non-Accredited Levee Systems" (also known as the Levee Analysis Mapping Procedure, LAMP), and has been deemed by FEMA to be the appropriate procedure for application landward of the San Francisco Bayfront in the absence of new modeling.*

**City Response:** The local communities including the City of San Bruno disagree with the FEMA-adopted over simplified bath-tub method and procedure for applying it thousands of feet inland of the Bay shoreline, without regard to frictional losses, tidal duration, or naturally varying tidal water levels. Rather than use this method landward of the San Francisco Bayfront in the absence of the new modeling, the City proposed an alternative approach of applying a dynamic hydraulic and hydrology modeling approach for more accurate results.

**FEMA Comment 3**

*The M&N Report proposes an alternative approach using the XP-SWMM model, which covers the City of San Bruno and the City of South San Francisco appeal areas. (The resolution of the City of South San Francisco submittal is handled separately from this appeal by the City of San Bruno). The XP-SWMM model used in this submittal is an accepted computer program for FEMA FISs, but has not been applied in any of the recently adopted FEMA Bay Area Coastal Studies. The M&N Report presents this alternative modeling approach with the claim that it can better account for the rise and fall of the tide and the flow over and around topographic features such as San Francisco Airport (SFO), and flow up streams, creeks and channel hydraulically linked from the San Francisco Bay flood source to the appeal area (and the Belle Air neighborhood). However, the M&N Report on upstream to downstream and overland flows in the XP-SWMM model did not provide any calibration or comparative analysis between measured data and computed results. Without validation, the modeling domain cannot be verified as being able to replicate the surge and tidal inundation processes for overland flow and flood routing up channels and streams.*

**City Response:** The City did utilize data from the calibrated and validated Bay model to develop the BFEs for SF Bay immediately offshore of San Bruno Creek and used the XP-SWMM model which is FEMA approved. The current model domain should be sufficiently large as it is selected based on the flood extent of the 0.2% annual chance flood boundaries shown in the Preliminary FIRMs. What is being appealed as scientifically incorrect is the use of the bath-tub approach, which ignores all flow constraints in the model domain including drainage channel dimensions, culverts, building structures, and roughness elements and applying it over large areas, thousands of feet inland of the Bay shoreline.

For this appeal, by using FEMA's specified approach for removal of uncertified levees and tidegate structures, it is not possible to obtain measured data for model calibration or verification since the communities have never been flooded in the past given that the uncertified SFO levees and tidegate do exist. All modeling parameters used in the analysis followed FEMA's



guidance, and the methodology is scientifically more accurate than the no-modeling, bath-tub approach (no calibration or verification) which does not replicate the surge and tidal inundation processes for overland flow and flood routing up channels and streams.

**FEMA Comment 4**

*The "design storm" hydrograph used in this submittal is event-based and developed to represent a single event consistent with a 1-percent-annual-chance flood. The M&N Report noted that the configuration of peak tides and flood duration is based on three historic coastal flood events in January 1983, December 1983, and February 1988. The resulting combination is scaled to a peak storm tide of 10.4 feet NAVD88 equal to a 1-percent-annual-chance flood level used in the Preliminary FIS and FIRM at the boundary with San Francisco Bay. The hydrograph used in this submittal was based on measured event data for the January 1983 storm, December 1983 event, and February 1988 event as recorded at the NOAA Alameda gage. It was not clear why more representative local gage measurements for the three events along the western bay shoreline were not used, such as those measurements at NOAA tide gages at Oyster Point Marina (NOAA #4392) and San Mateo Bridge (NOAA #4458), located north and south of the appeal area.*

**City Response:** The above comment is incorrect. We would like to clarify that:

1. No recorded data or shape from NOAA tide gages were used in the modeling conducted for the appeal. The shape of tide series was from the FEMA's Bay model and the peak elevation was based on FEMA's BFE in the Bay.
2. The base storm event used to develop the shape was the February 1998 event (not February 1988 as listed in the comment).

As stated in Section 3.2.1 of M&N Report, the 54-year water level time series developed for FEMA's "Regional Coastal Hazard Modeling Study for North and Central San Francisco Bay" (DHI, 2011) were utilized. The DHI study developed hourly water levels between 1956 and 2009 along the entire San Francisco Bay coast. Figure 1 below (Figure 7 in M&N Report) shows twelve DHI model output locations where time series of hourly water surface elevations were available (DHI, 2011). Comparison of water level time series at the 12 locations indicates the water levels are pretty consistent between these locations and Location 12 has slightly higher water levels than the other 11 locations. Therefore, three storm time series with the highest peak elevations at Location 12 were identified from the DHI model output and compared. The hydrograph pattern of the February 1998 time series ("shape" of the hydrograph to develop tidal duration) was selected as it has the longest duration of elevated water levels; hence, it is a relatively more conservative event. The February 1998 time series were then scaled to match a peak storm tide of 10.4 feet NAVD88, which is the 1%-annual-channel flood level used in Preliminary FIS and FIRM at the boundary of San Francisco Bay.

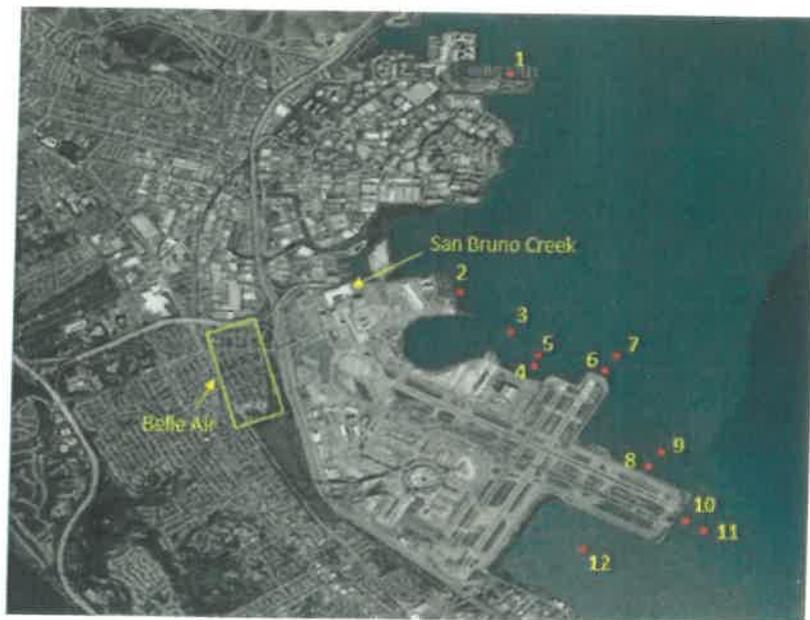


Figure 1: Exhibit of DHI Bay Model Output Locations

**FEMA Comment 5**

*The most notable deficiency found in the M&N Report and technical approach is the use of the event-based approach, which conflicts with the latest recommendations developed by FEMA for the Pacific Coast region in 2005 for use in San Francisco Bay and open Pacific coast. In this FEMA Pacific coast guidance, an approach was presented for evaluating the 1 -percent-annual chance flood, based on the concept of "system response analyses" rather than traditional "event analyses." This means that the open waters of inland bays and oceans should follow the response approach, which uses a historic record of measured or predicted wave conditions along with simultaneously measured or predicted water-levels to determine site-specific storm response parameters, such as maximum water levels at points of interest. This approach is more robust than an event analysis that relies on a set time-dependent wave level condition with a specific duration. To be consistent with a "system response analysis," the appeal should have utilized water levels driven by the FEMA 54-year hindcast study as boundary condition forcing to the XP-SWMM modeling. This would allow for the largest response from each of the 54 years to be used as annual maxima for the entire period of record and analyzed (by statistical analysis) to determine the 1-percent-annual-chance flood response for overland flow conditions. Any new modeling should follow the FEMA Pacific region guidance and use of the existing spatially varying 54-year time series along the boundary for tidal forcing.*

**City Response:** The City would like to point out that FEMA's bath-tub (Natural Valley) approach to mapping is not a response-based approach, rather it is an overestimated event-based approach. The City's approach used in the appeal is a more scientifically accurate hybrid



approach where a response-based BFE developed by FEMA was used to drive an unsteady, two-dimensional flow model to propagate the statistically derived BFE inland.

The City would like to note that the *Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States*, dated January 2005 do not exclude Hybrid or even Event-Based approaches. As stated in Section D.4.3.2 (Event vs. Response Statistics) “*Whatever methods are used, simplifying assumptions are inevitable, even in the most ambitious Response-Based study, which attempts to simulate the full range of important processes over time,*” and “*No fixed set of rules or cookbook procedures can be appropriate in all cases, and the Mapping Partner must be alert to special circumstances that violate the assumptions of the methodology.*” As stated in Section D.4.3.2.1, *the Event-Based approach may allow reasonable estimates to be made with minimal cost if used with caution.* As stated in Section D.4.3.2.3 (Hybrid Method) *Circumstances may arise for which the Mapping Partner can adopt a hybrid method between the event-based and response-based extremes.*

The City would also like to note that the FEMA recommended response-based approach would not work for the area being appealed, which is Belle Air neighborhood south of the Pine Street. The area is potentially exposed to three flood sources as stated in Section 3.4.2 of M&N Report, but it would not be flooded even under the largest storm events. The three potential flood sources and flood risks are:

- 1) San Francisco International Airport (SFIA). The flood water would overtop Hwy101 after the SFIA is flooded. The lowest elevation of that segment of Hwy 101 is +9.4 feet NAVD88. All storm events in the 54-year time series with a peak elevation above 9.0 feet NAVD88 are listed in Table 1. There is only one storm event that would have the potential to overtop the Hwy101 even assuming no flood attenuation.
- 2) Cupid Row Canal. The lowest bank elevation of the Canal is +9.2 feet NAVD88. Only four storm events would have the potential to overtop the bank of the Cupid Row Canal, again assuming no flood attenuation.
- 3) Millbrae. The low coastline of Millbrae would allow flood waters to enter and flow north along Hwy 101, and then into the Belle Air Neighborhood. The current modeling results indicate that flood waters would not reach the Belle Air Neighborhood even with a peak elevation of +10.4 feet NAVD88 due to long flood routing distance and limited flood duration and flood volume.

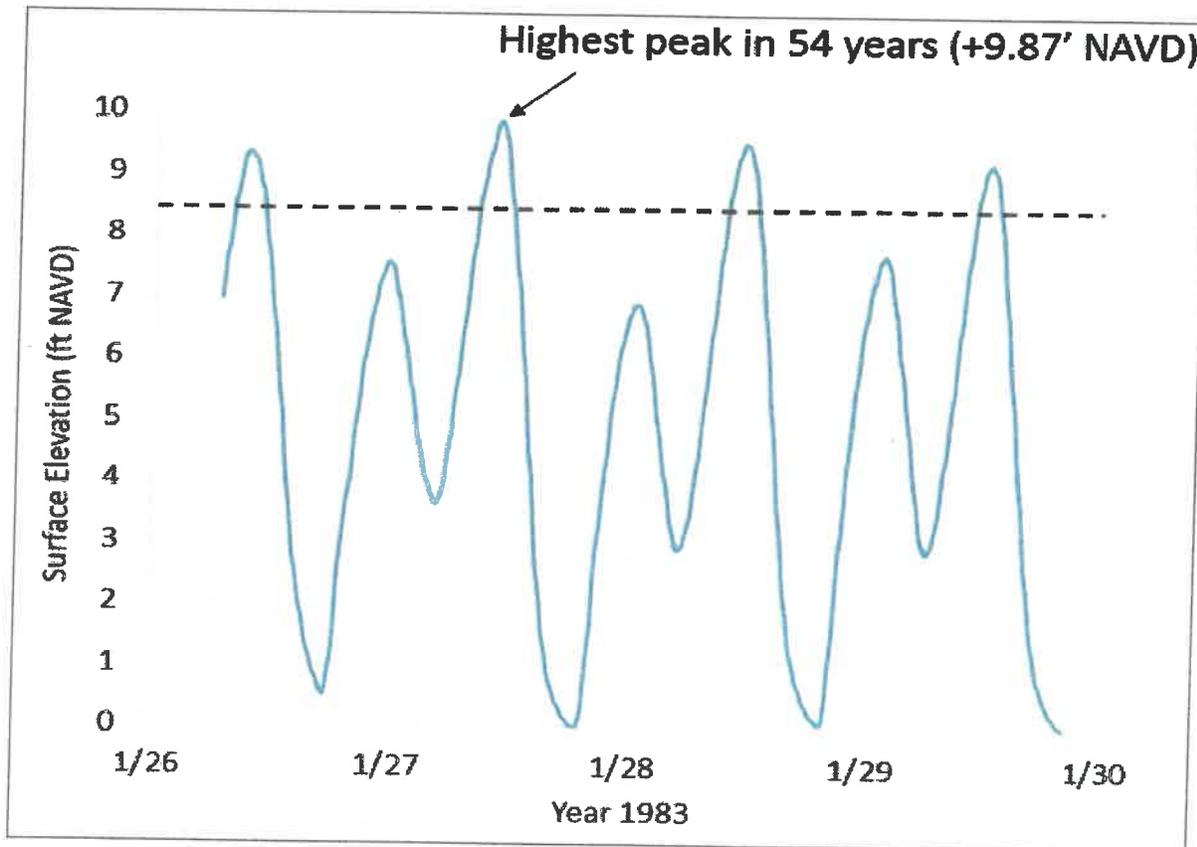
In summary, if the suggested response-based approach is used by applying the 54-year time series at the model boundary, there would only be four potential storm events in the Bay as shown in Table 1 that would have the potential to flood the northern part of the Belle Air Neighborhood and none that would reach south of Pine Street. Four storm events are statistically insufficient in terms of sample space to perform extremal analysis to result in the 1%-annual-chance of flood. A more detailed discussion about why a response-based approach would not work is detailed below.



**Table 1: Storm Events with Elevation above 9.0 ft NAVD88 (Extracted from 54-yr time series, DHI 2011)**

Ranking	Peak Elevation (ft, NAVD88)	Date	Duration of Elevation > 8.5 ft NAVD88 (day)
1	9.87	January 1983	5
2	9.38	December 1983	1
3	9.29	February 1998	2
4	9.25	January 1973	3
5	9.13	December 2005	1
6	9.12	November 1982	1
7	9.05	December 2003	1
8	9.04	January 2005	1
9	9.02	January 1969	1
10	8.98	February 1958	3

As part of the appeal development, the City had performed XP-SWMM numerical modeling run for the largest storm (the January 1983 storm) by driving the model with time series extracted from the FEMA's 54-year hindcast study. The time series applied in the XP-SWMM model boundary is shown in Figure 2. A black dash line with an elevation of +8.5 feet NAVD88 is included as this is the elevation that the coastal flood would start to overtop banks of creeks. In other words, it is the lowest bank elevation.



**Figure 2: The Largest Storm Series from FEMA's 54-Year Hindcast**

The modeling results as shown in

Figure 3 indicate the Belle Air neighborhood south of Pine Street (shown inside the yellow polygon) being appealed will not be flooded with the largest storm event. The flooding extent in the area north of Pine Street is also less than that was presented in the appeal (shown as aqua blue line) which was modeled with a peak elevation of +10.4 feet NAVD88 equal to a 1%-annual-chance flood level used in the Preliminary FIS and FIRM. Figure 4 shows a location where time series of flood water level is extracted from the XP-SWMM model and the resulting time series is presented in Figure 5 together with the model boundary input. The maximum water level in the Belle Air Neighborhood north of the Pine Street is +9.3 feet NAVD88, which is more than 1 foot lower than the 10.4 feet elevation with the FEMA's bath-tub approach.

In conclusion, performing a continuous 54-year model run and then conducting extreme value statistics to estimate the BFE would not work as the area would never be flooded over the 54-years; hence, there would be no data points to conduct the statistical analysis. Therefore, a response-based method does not apply in this case. The City's hybrid approach provides a scientifically more accurate even if somewhat conservative (produces higher BFE) result.

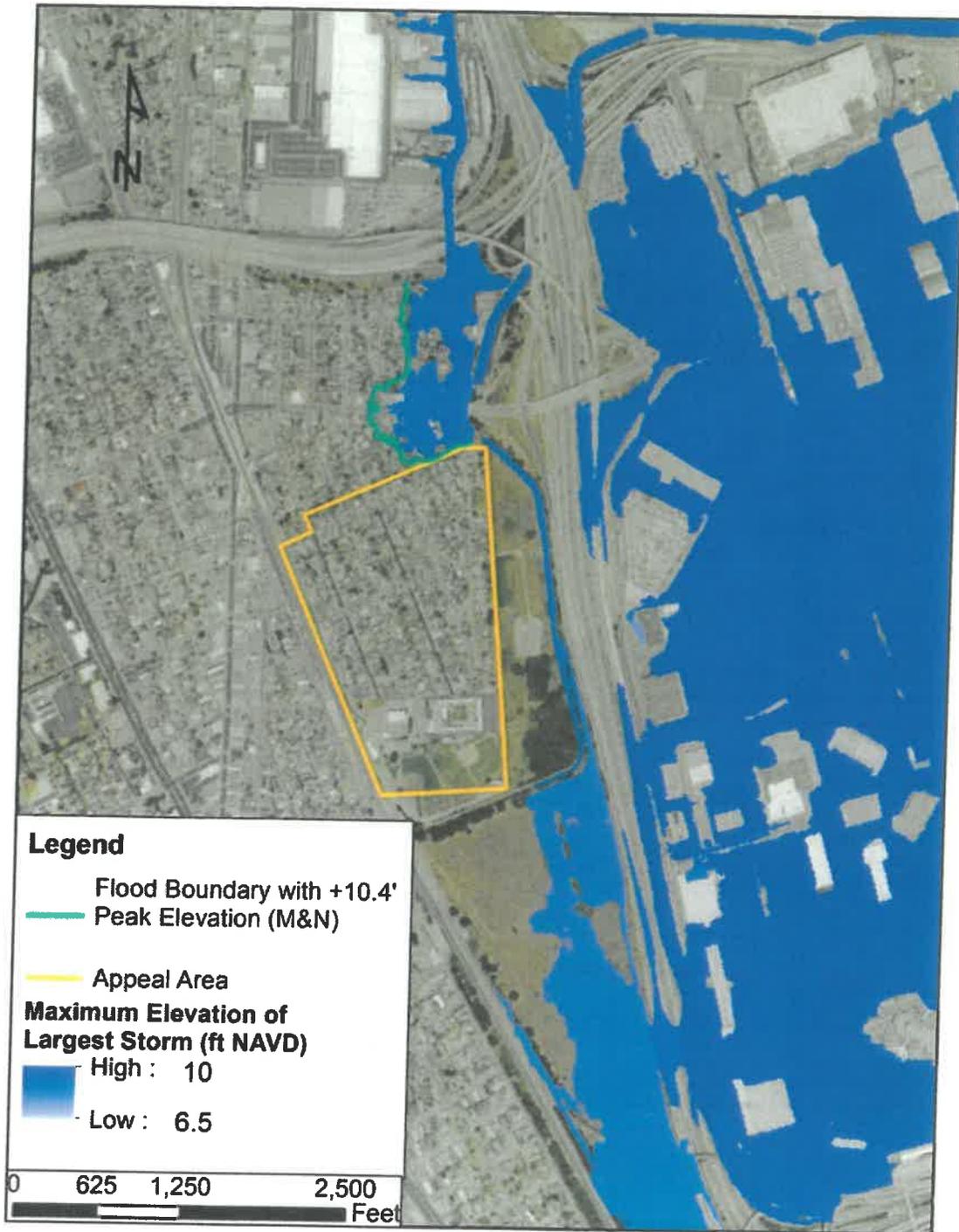
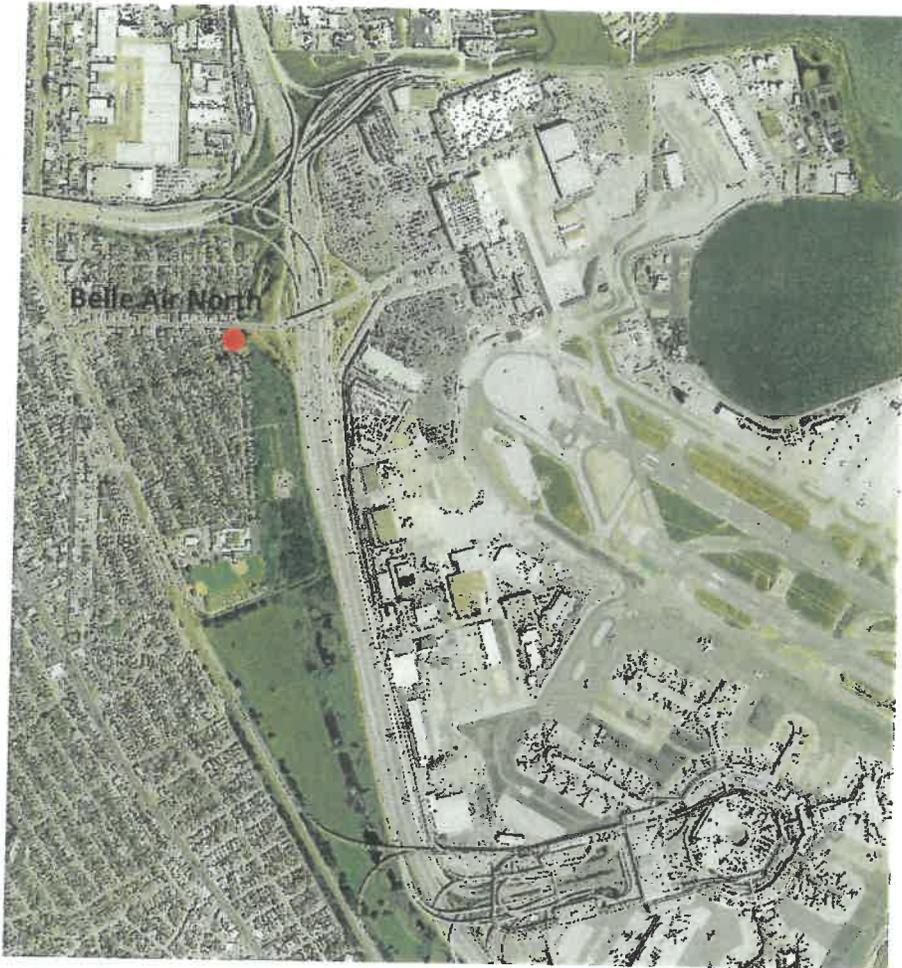


Figure 3: Flood Inundation Map with the Largest Storm Series from the 54-Year FEMA Hindcast



**Figure 4: XP-SWMM Gage Location in Belle Air Neighborhood North of Pine Street**

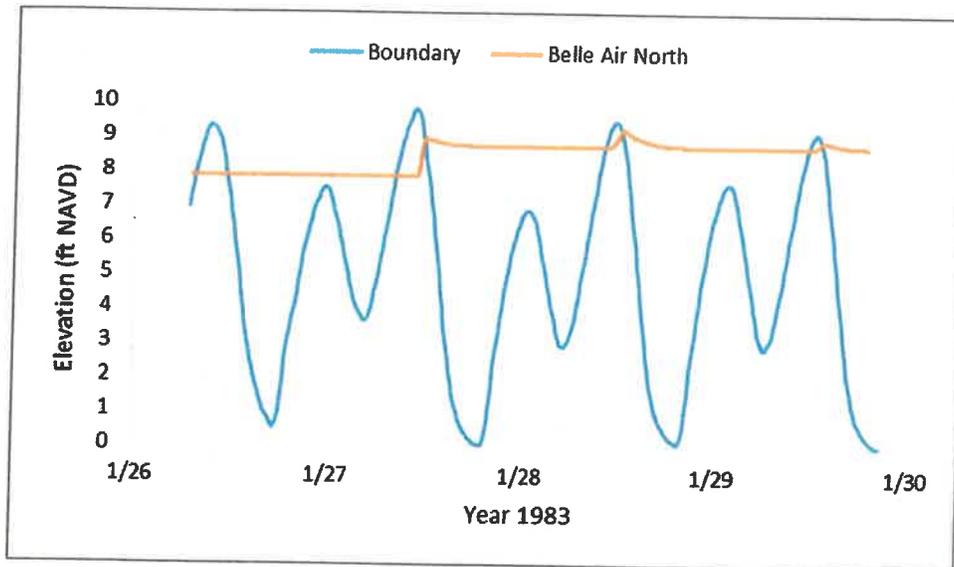


Figure 5: Flood Level Time Series in Belle Air Neighborhood North of Pine Street

**FEMA Comment 6**

NFIP regulations require submittal of the proposed map and resulting revisions to the Preliminary FIRM and FIS. This would be included in a digital data submission for Preliminary FIRM revisions, and show the flooding limit boundaries of the 1-percent-annual-chance SFHAs, BFEs, and all tie-ins to surrounding Preliminary and Effective FIRM mapping. Revisions to the Preliminary FIS should include all changes to the text, tables, and figures describing the revised modeling approach and revised results to be shown on a Revised Preliminary FIRM. In review of the City of San Bruno appeal submittal, we found no such proposed revisions to the August 13, 2015 Preliminary FIRM or FIS products.

**City Response:** The proposed map and resulting revisions to the Preliminary FIRM and FIS are shown in Figures 19 and 20 of the M&N Document. The digital GIS shapefiles are included in the digital submission. The City is willing to prepare additional map items required upon approval of this appeal.



FEMA

## Scientific Resolution Panel Request Form

*This form is to be completed by the community's Chief Executive Officer (CEO) or the authorized representative of the community for which the appeal is being filed. The CEO will consolidate all unresolved appeals by private persons and submit them on their behalf. The CEO will also forward to FEMA copies of appeals not endorsed by the community and certify that no further appeals will be brought to FEMA for the community.*

Date: 12/9/2016

Name of Community: City of San Bruno

County and State of Community: San Mateo County, CA

Name of Community CEO or authorized representative: City Manager Connie Jackson

Mailing Street Address: 567 El Camino Real

City: San Bruno State: CA Zip: 94066

Phone Number (Work): (650) 616-7056

Phone Number (Cell): \_\_\_\_\_

Email Address: cjackson@sanbruno.ca.gov

Does the data submitted constitute an **appeal**? (Y/N)  
-Yes

If yes, does the submitted data satisfy the data requirements outlined in 44 CFR Section 67.6 (b) of the National Flood Insurance Program (NFIP) regulations and demonstrate that FEMA's proposed flood hazard determinations (proposed flood hazard determinations may include the addition or modification of Base Flood Elevations (BFEs), base flood depths, Special Flood Hazard Area (SFHA) boundaries or zone designations, or regulatory floodways) are:

- (1) technically incorrect due to a mathematical or measurement error or changed physical conditions?
- (2) technically incorrect due to error in application of hydrologic, hydraulic or other methods or use of inferior data in applying such methods?
- (3) scientifically incorrect

If an oral presentation to the SRP is necessary to support this appeal, please justify here.

The City and consultant are available to provide an oral presentation to the SRP to clarify the appeal issues.

### **Community Commitment and Certification**

The community certifies that:

1. the data provided for SRP review was entirely submitted to FEMA during the 90-day appeal period.  
 Y  N
2. no additional data will be submitted for this or any other appeal for SRP consideration.  
 Y  N

No, the city is willing to provide additional information if requested by FEMA or the SRP.

3. there may be no submission of any other appeals not consolidated with this submission.  
 Y  N

### **Location of Contested Flood Hazard Determination Data**

4. *Identify the specific river reaches or coastal transects challenged by the data.*  
The Belle Air Neighborhood South of Pine Street
5. *Please identify areas of expertise the community believes are pertinent for representation on the SRP.*  
Coastal Engineering, advanced numerical modeling, FEMA guidelines

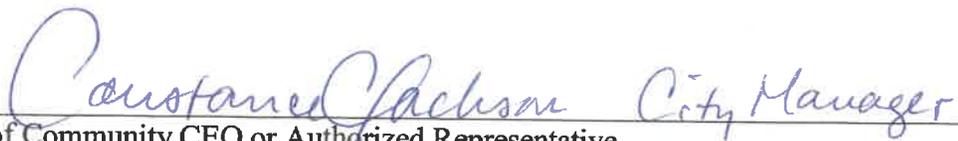
- 6. Description of information to be submitted by the community indicating that the flood hazard data proposed by FEMA are scientifically or technically incorrect**  
*Please include on a separate page labeled "Attachment A: Summary of Appeal Information" a summary of the specific technical issues, errors in FEMA's data, or different technical processes submitted to contest the flood hazard determination data proposed by FEMA.*

The appeal information submitted to the FEMA include an August 19, 2016 report prepared by Moffatt & Nichol entitled "FEMA APPEAL DOCUMENT, City of San Bruno," digital data submission including XP-SWMM 1D/2D integrated hydraulic model files, model input and outputs in ArcGIS format, and animation showing the inundation during the simulated flood event.

A brief summary of appeal information is included in Attachment A.

- 7. Acceptance by Community of Terms and Conditions for the Initiation of an SRP**  
*To initiate the SRP process, the community's CEO or authorized representative must accept the following terms and conditions on behalf of the community and individuals whose appeals are consolidated with this submission.*

- a) The community understands that the FEMA Administrator is not required to accept the recommendation of the SRP, and that upon the Administrator's final determination that no further consideration will be given to the community's appeals. The parties will maintain their right to appeal to the appropriate Federal District Court pursuant to 44 CFR Section 67.12 of the NFIP regulations.
- b) The community has read the FEMA-prepared Guidance Memorandum titled "Implementing the Scientific Resolution Panel Process" and agrees to work with the National Institute of Building Sciences (NIBS) in the timely completion of the SRP review, including timely selection of panel members and participation in additional review procedures if requested.
- c) The community agrees that no contact will be made with the Panel members except as expressly requested by NIBS before, during or after the SRP review is undertaken.
- d) The community agrees that they have read and signed the "Community Submittal Agreement."

  
Signature of Community CEO or Authorized Representative

***Attachment A: Summary of Appeal Information***

The City contested that:

- The proposed BFEs in the City's preliminary FIRMs are scientifically incorrect; and
- The designations of the identified SFHAs in the City's preliminary FIRMs are scientifically incorrect.

In the preliminary FIRM, FEMA adopted method for the Bay Area Coastal Study is the "Natural Valley" or "Without Levee" approach. In this approach, the 1-percent- annual-chance SWEL is extended behind or landward of non-accredited structures and non-levee embankments to a point where the 1-percent-annual-chance SWEL floodplain boundaries are equal to controlling ground elevations. The approach did not consider frictional losses, tidal duration, naturally varying tidal water levels, and the topographic changes (culverts, buildings, creeks, highways, etc.). The approach is a no modeling bath-tub approach, which leads to overly conservative results for SFHA zones in the City.

The City used an alternative approach using the XP-SWMM model. The XPSWMM model is a fully dynamic hydraulic and hydrologic modeling software that combines 1D calculations for upstream to downstream flow with 2D overland flow calculations. The model is approved by FEMA for 2D flood modeling and mapping for the NFIP since 2011. The alternative modeling results show much less area of flooding in the Belle Air neighborhood. Therefore, the City is appealing the SFHA flood boundary and Zone designation revisions in its Belle Air neighborhood south of Pine Street.